NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION

CONSTRUCTED WETLAND

(acre)

Code 656

GENERAL SPECIFICATION

Procedures, technical details and other information listed below, provide additional guidance for carrying out selected components of the named practice. This material is referenced from the conservation practice standard for Constructed Wetland and supplements the requirements and considerations listed therein.

Purpose

The purpose is to create wetlands to treat wastewater runoff from fields, feedlots, stockyards, and areas of livestock concentrations. Wastewater runoff is treated by placing it within a created wetland that will utilize excess nutrients. The wetland will also prevent the runoff from entering nearby waterways thus helping to control surface water quality degredation.

CRITERIA

This practice should be considered only if one or more of the following criteria apply:

- Waste water currently flows into a live stream.
- Waste water flows continually or seasonally and is more than storage facilities can hold.
- Waste water has the opportunity to pollute ground water.
- Waste water amount exceeds the annual evaporation for the local area.
- Waste water flows off site.
- Nitrates and other pollutants do not exceed 100 ppm.

Each system will include the following components:

1st Stage. Settling basin – water flowing through a rock and gravel section. This settles suspended solids and begins to break down ammonia.

2nd Stage. Grass/sedge/rush filter. Aeration and more break down of ammonia by bacteria. Filtering of suspended material.

3rd Stage. Aquatic plant filter – 6- 12 inch water depth. Nitrates are now being used by plants and chemical compounds are being converted. Metals are adsorbed by soils.

4th Stage. Deep water basin – 18 – 36 inch water depth. Water is filtered by animals and final uses of nitrates by plants; soil adsorbs metals; suspended solids are settled again.

5th Stage. Finish basin containing riparian vegetation. Final use of remaining nitrates, filtering of suspended material, and aeration.

The system must remain aerobic in order to prevent production of ammonia and other toxic products. This is accomplished by maintaining a constant flow through the system and removing dead plants. Total detention time of water in the system will not exceed 15 days. Longer detention times will result in the system beginning to become anaerobic and start producing harmful products.

PLANS AND SPECIFICATIONS

Specifications for this practice shall be prepared for the created wetland. Specifications shall vbe recorded using approved specification sheets, job sheets, narrative statements in the conservation plan, or other acceptable documentation.

National Pollution Discharge Elimination System (NPDES) Permit will be obtained by the owner prior to planning.

SOIL

Soils must contain enough clay or fine materials, and organic material to be able to function as hydric soil. Soil particles will adsorb, or stick heavy metals to them, over time until it may be necessary to remove the top layers and replace with clean soil.

WATER AMOUNTS

An adequate amount of water to operate the system must be secured prior to construction. This determination should be accomplished early in the planning process. The system shall be designed to retain an amount of water to keep plants alive during periods of non-use or inactivity. These periods may occur between irrigation cycles; feed lot shut down, seasonal non-production times, etc.

WATER DILUTION

If raw polluted water contains more than 100 ppm ammonia it must be diluted with fresh water to bring it down. Dairy waste water typically contains 1800 to 3500 ppm ammonia hog farms are similar. The dilution factor may be such that the practice becomes unfeasible.

DESIGN PARAMETERS

- Slope 0.05 %
- BOD = 70 kg/ha/day
- Total suspended solids = 70kg/ha/day
- TKN = 7 kg/ha/day
- NH3 = 7 kg/ha/day
- Flow rate = 5-6 liters /minute (1-1.5 gal/min)

POND SEALING

Excavated ponds shall be sealed to prevent deep percolation and back filled with soil suitable for plant growth. This is especially true for waste water containing pesticides, medicines, disease bacteria or viruses.

Evaporation should not exceed four vertical feet annually. Excessive evaporation makes it difficult to keep the wetland alive without supplemental water application.

PLANT COMPONENTS

The excessive nutrient levels in the waste water will cause prolific plant growth each year, therefore provisions must be made to harvest plant biomass. This can be done in a number of ways including mechanical mowing, chopping, shredding, etc. Only the top growth of the plants will be removed. Tubers, roots, rhizomes and the like must stay in the wetland for continued use.

This harvested plant material may have value for animal feed, fireplace fuel, soil amendments, mulch, etc.

Plants must be cold tolerant and salt tolerant to survive.

The following plants are suitable for use in New Mexico:

2nd Stage plants

- Manna grass (Glyceria species)
- Rushes (Juncus species)

3rd Stage plants

- Cattails (Typha)
- Rushes (Juncus species)
- Bull rush (Scirpus species)

4th Stage plants

- Duckweed (Lemna minor)
- Water lilly (Various species)

5th Stage plants

- Willows (Salix species)
- Reeds (Phragmites communis)

ANIMAL COMPONENTS

Some animals can be highly effective in the wetland for several purposes. Mosquito fish in the fourth stage, deep water, will feed on insects especially mosquito larvae. Fresh water clams found in the rivers of New Mexico, have the ability to filter nutrients from the water at the rate of 12 gallons/hour for a 3 inch clam. Clams will also utilize nutrients in the bottom mud.

Use of the constructed wetland by wildlife should be discouraged if heavy metals, pesticides or other toxic substances are to be the featured pollutants to be removed. Most substances will be rendered non-toxic by the wetland if processed properly, with the exception of selenium, which will be concentrated in the water and can be toxic to birds and mammals. Heavy metals will attach to soil particles and will accumulate over time. Many pesticides will be converted to non-toxic compounds by plants especially by duckweed.

WATER QUALITY

The purpose of this practice is to improve water quality including surface runoff, ground water, off-site flows, etc.

The treated water coming out of the system must meet state standards for the intended uses.

- BOD = < 30 mg/l
- TSS =
- Ammonia = <
- TDS =

If selenium is present in the waste water do not continue with planning. Selenium, unlike other pollutants will not be attached to soil particles, nor be broken down, nor be used by plants. Selenium will move with water, be taken up by waterfowl, animals and generally be concentrated in the wetland. While selenium is used by animals in minute amounts, a very small amount is toxic.

The very first step in the planning process is to inventory resources and in this case a water analysis is essential as a benchmark starting point for design work later.

OPERATION AND MAINTANENCE

The created wetland must receive enough water and effluent throughout the year to assure the plant and animal survival.

Water quality parameters must be checked frequently for the first year of operation to insure that the wetland is

functioning as planned. In the south western US extreme dilution of pollutants may be required to reduce toxic levels so that microorganisms are not killed.

Structures will be inspected frequently for damage and wear.

Plants must be replaced periodically to maintain proper amounts.

Plant harvest will be done each year in the fall to remove excess growth and make room for next year.

Animals in the system must be checked periodically to insure their survival and thus functionality.

REFERENCES

Cronk, J. 1996. Constructed wetlands to treat wastewater from dairy and swine operations: a review. Agriculture, Ecosystems, and Environment 58 (1996): 97-114.

Davis, L. A handbook of constructed wetlands: a guide to creating wetlands for: agricultural wastewater, domestic wastewater, coal mine drainage, stormwater in the Mid-Atlantic region, Volume 1: general considerations. USDA-NRCS, U.S. EPA--Region III, and PA. Dept. of Environmental Resources.

DuBowy, P.J. and R.P. Reaves, editors. 1994. Constructed wetlands for animal waste management: proceedings of a workshop; 1994 April 4-6; Lafayette, IN. Dept. of Forestry and Nat. Resources, Perdue University.

Hammer, D.A. (editor), 1990. Constructed Wetlands for Wastewater Treatment, Municipal, Industrial and Agricultural, Lewis Publishers, Ann Arbor, MI.

Environmental Protection Agency, 1993. Created and Natural Wetlands for Controlling Nonpoint Source Pollution. Lewis Publishers, Ann Arbor, MI.

Steiner, G. R. and Watson, J.T., 1993. General design, construction, and operation guidelines: constructed wetlands wasterwater treatment systems for small users including individual residences. 2nd edition. Tennessee Valley Authority, TVA/WM--93/10, May 1993.

Surrency, D., C.M. Owsley, and M. Latimore, 1996. Guidelines for establishing aquatic plants in constructed wetlands. USDA-NRCS and Fort Valley State University, GA.

US Department of Agriculture, Natural Resources Conservation Service, 1991. Environmental Quality Technical Note No. N4, Nutrient and Sediment Control System. USDA, NRCS, Chester, PA.

US Department of Agriculture, Natural Resources Conservation Service, 1992. Wetland Restoration, Enhancement, or Creation, Chapter 13, Part 650, Engineering Field Handbook. USDA, NRCS, Fort Worth, TX..

Hammer, Donald. Constructed Wetland for Wastewater Treatment, CRC Press, 2000 Corporate Blvd., Boca Raton, FL., 33431. 1991.

Wengrzynek, Robert. Constructed Wetlands in Water Pollution Control, SCS, 1991.